

A PROBLEMATICAL DINOFLAGELLATE FROM THE TERTIARY OF VIRGINIA AND MARYLAND

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ABSTRACT. *Inversidinium exilimurum*, gen. et sp. nov., a problematical dinoflagellate recovered from the Aquia Formation (Upper Paleocene) of the Virginia-Maryland Coastal Plain, displays an atypical peridinioid outline characterized by a truncated antapex which ruptures to form a hitherto unreported type of antapical excystment apparatus; antapical archeopyles are exceedingly rare among the dinoflagellates.

IN the Cretaceous and Tertiary dinoflagellate and acritarch assemblages of the Virginia-Maryland Coastal Plain are problematical palynomorphs of which the morphological interpretation and taxonomic treatment cannot be unequivocally assessed. A cyst recovered from the marine Aquia Formation (Upper Paleocene), displays characteristics which suggest affinities with the Pyrrhophyta; however, interpretation of these characters is subjective. Its outline compares most closely with that of a peridinioid but is atypical by having a truncated antapex which lacks antapical horns; the excystment apparatus (= archeopyle?) does not conform in shape or position with any thecal plate, or combination of plates, known to the author; and features of the periphragm which seemingly correspond in position to a cingulum and sulcus are reflected not by indentations, but by convex-outward folds. Orientation of the cyst is subjective. By comparison with a general peridinioid outline, the pointed tip of the periblast is considered apical and the truncated end showing the excystment feature, antapical. In addition, convex-outward folds of the periphragm which correspond in position to a cingulum and sulcus seemingly reflect dorsal and ventral surfaces, respectively. Following this orientation, the cyst is interpreted to have a hitherto unreported type of antapical excystment apparatus. Antapical archeopyles are exceedingly rare among dinoflagellates.

All samples are from the Aquia Formation (Upper Paleocene) of the Virginia-Maryland Coastal Plain from outcrop localities along the Potomac River south of Washington, D.C. They are:

Locality 1. Prince Georges County, Maryland. Reference: U.S. Geol. Svy. Anacostia, Md.-D.C. quad., 7.5 minute series; geog. coords. $38^{\circ} 45' 10''$ N. Lat., $76^{\circ} 59' 15''$ W. Long. Approx. 45 feet (14 m) of lowermost Aquia glauconitic quartz sands are exposed about 0.5 mile (0.80 km) west of Friendly, Maryland, along the stream occurring immediately south of, and paralleling, the Old Fort Road.

Locality 2. Stafford County, Virginia. Reference: U.S. Geol. Svy. Passapatanzy, Va.-Md., quad., 7.5 minute series; geog. coords. $38^{\circ} 22' 15''$ N. Lat., $77^{\circ} 17' 50''$ W. Long. This is the type locality of the Aquia Formation. Approximately 70 feet (21 m) of Aquia glauconitic quartz sands are exposed in the bluffs along the south bank of Aquia Creek, about 0.5 mile south-east of the Maryland-Virginia Monument No. 37.

Locality 3. Stafford County, Virginia. Reference: U.S. Geol. Svy. Passapatanzy, Va.-Md., quad., 7.5 minute series; geog. coords. $38^{\circ} 20' 35''$ N. Lat., Long. $77^{\circ} 17' 17''$ W. Long. Approximately 35 feet (10 m) of Aquia glauconitic quartz sands are exposed in the bluffs along the south bank of Potomac Creek, from 0.5 and 0.15 mile west of the Maryland-Virginia Monument No. 35.

Standard acid maceration techniques were utilized for all samples. Palynomorphs were concentrated by use of ZnBr (sp. gr. = 2.0), and were darkened for study and photomicrography by acetolysis. Slides are stored at Stanford University and are assigned Stanford University Paleontological Type Collection (= SUPTC) numbers. Coordinates are measurements in millimetres to the right (R) or left (L) and toward the top (+) or bottom (−) of the slide from an index cross engraved on the coverslip near its lower left corner.

SYSTEMATIC PALAEOLOGY

Division PYRRHOPHYTA Pascher

Class DINOPHYCEAE Pascher

Genus INVERSIDINIUM nov.

Derivation of name. Latin, *inversus*, inverted, with reference to the antapically oriented archeopyle.

Type species. *Inversidinium exilimurum* sp. nov.

Diagnosis. Bi-layered cyst; periblast outline peridinioid with pointed apex and truncated antapex; lacks indications of tabulation; endoblast outline variable. Convex-outward folds of the periblast reflect cingulum and sulcus. Excystment apparatus (= archeopyle?) antapical; forms by rupture of antapical tips of periblast and endoblast. Periphragm and endophragm externally smooth to granulose.

Remarks. *Inversidinium exilimurum*, gen. et sp. nov., is assigned to the Pyrrhophyta on the basis of its generalized peridinioid shape, excystment apparatus, and features of the periphragm that seemingly reflect a cingulum and sulcus.

Inversidinium exilimurum sp. nov.

Plate 90

Derivation of name. Latin, *exilis*, thin or meagre; *murus*, wall-in reference to the thin, transparent nature of the periphragm and endophragm.

Holotype. Pl. 90, figs. 1–2. Loc. 2, sample 3384, SUPTC 10079 (R26.0, +12.5).

EXPLANATION OF PLATE 90

Inversidinium exilimurum, gen. et sp. nov.; all specimens are from the Aquia Formation (Upper Paleocene) of the Virginia–Maryland Coastal Plain.

Figs. 1–2. Holotype, $\times 920$. 1, Shows details of ventral longitudinal ridge; dorsal transverse ridge is shown in optical section on left side of specimen. 2, Shows general peridinioid outline of periblast and triangular outline of endoblast; note truncated antapex of periblast and complete absence of antapical horns. Dimensions: $L \times W = 50 \times 40 \mu\text{m}$. Loc. 2, sample 3384, SUPTC 10079 (R26.0, +12.5).

Figs. 3, 6. Two focus levels of one specimen oriented with antapex facing the observer and ventral surface facing up. 3, Transverse optical section at level of dorsal transverse ridge, $\times 1340$. The bulge facing up in the photograph shows in cross section the ventral longitudinal ridge. 6, Antapical tip of periblast, $\times 1710$. Maximum width of specimen $35 \mu\text{m}$. Loc. 1, sample 3370, SUPTC 10080 (R14.2, +4.3).

Figs. 4–5. Two views of one specimen, $\times 925$. 4, Shows optical section of triangular endoblast; note ruptured antapex of both periblast and endoblast. 5, Phase contrast, shows details of ruptured antapex of both periblast and endoblast. Dimensions: $L \times W = 54 \times 45 \mu\text{m}$. Loc. 2, sample 3390, SUPTC 10081 (R19.0, +12.0).

Figs. 7–9. Several focus levels of one specimen oriented with antapex facing observer and ventral surface facing up, $\times 2000$. 7, Transverse optical section at level of dorsal transverse ridge showing optical section of ventral longitudinal ridge. 8, Focused on extreme antapical tip of periblast. 9, Antapical view of periblast focused slightly deeper into specimen than in fig. 8, showing what is interpreted to be a circular excystment aperture (= archeopyle?). Maximum width of specimen $40 \mu\text{m}$. Loc. 2, sample 3392, SUPTC 10082 (R24.3, +1.5).



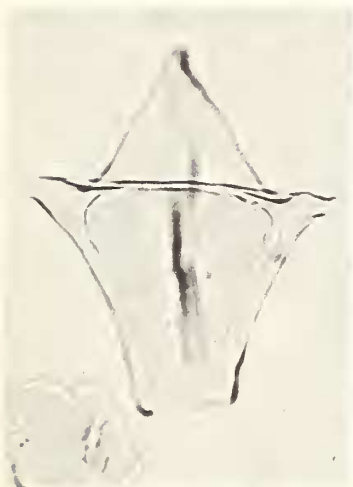
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Diagnosis. As for genus.

Description. Periphragm transverse section elliptical at widest part and triangular at antapex. Endoblast dorso-ventral outline roundly triangular with elliptical transverse section at widest part and triangular cross section at antapex; endoblast occupies hypotractal portion of periblast. A narrow convex-outward fold 1–3 μm wide traverses periblast dorsal surface at its widest part; a similar fold extends longitudinally along the periblast ventral midline from the antapex to about midway between the widest part of the periblast and the apex. Excystment apparatus (= archeopyle?) forms by posterior tip of endophragm breaking away and posterior tip of periphragm rupturing irregularly. Periphragm and endophragm less than 1 μm thick, transparent, and externally smooth to granulose.

Dimensions. Holotype $L \times W = 50 \times 40 \mu\text{m}$. Observed range (eleven specimens measured): length 45–60 μm (mean 51 μm); width 32–52 μm (mean 41 μm).

Remarks. The narrow convex-outward folds on the dorsal and ventral surfaces of the periblast are commonly folded secondarily such that the resultant deformed folds have the appearance of furrows. Rotation of such specimens into both lateral and polar views, so that the features could be examined in cross section, confirmed that they are convex-outward folds that had been folded secondarily and are not furrows. Rupture of the periphragm along the crests of the folds has not been observed.

Comparison with similar species. *Inversidinium exilimurum*, gen. et sp. nov., is unique among the Pyrrhophyta with the possible exception of *Wetzelietta* (*Rhombodinium*?) *minuscula* Alberti, 1961, which resembles the new species in appearance. They differ in details concerning the antapex and shape of the endoblast. According to Alberti's description, *W. (R?) minuscula* exhibits two antapical protrusions separated from one another by means of a longitudinal split; *I. exilimurum*, on the other hand, has a sharply truncated antapex that lacks any vestige of protrusions (horns) and has an outward-convex fold along its ventral midline instead of a split. The endoblast of *W. (R?) minuscula* is rhombohedral in outline and nearly fills the periblast whereas that of *I. exilimurum* is triangular in dorso-ventral outline and occupies the hypotractal portion of the periblast.

W. (Rhombodinium?) minuscula lacks the intercalary type archeopyle typical of *Wetzelietta*, thereby raising questions concerning its assignment to *Wetzelietta*. Should later investigations show it to have an antapical excystment apparatus, it should then be transferred to *Inversidinium*.

Occurrence. Loc. 1, less than 1% of the phytoplankton content through all but the upper 20 feet of the section; Loc. 2, less than 1% of the phytoplankton content throughout the section; Loc. 3, less than 1% of the phytoplankton content of one sample taken 20 feet above the base of the section.

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